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Food of incidental fish species taken in the purse-seine skipjack fishery, 1976-81

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and G. Habib

Fisheries Research Division
Occasional Publication: Data Series No. 6

Food of incidental fish species taken in the purse-seine skipjack fishery, 1976-81

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Introduction

Each summer since late 1975 there has been a commercial purse-seine fishery for skipjack tuna (*Katsuwonus pelamis*) in New Zealand waters. Reports on each summer's fishing and skipjack catches between 1975 and 1981 are presented in Fisheries Research Division Occasional Publications No. 11, 15, 25, 26, 29, and 36.

Although seining was aimed at catching skipjack, many other fish species were taken incidentally in the catches. Catch and size data on those species are presented or referred to in Fisheries Research Division Occasional Publication: Data Series No. 5. On some vessels the stomach contents of the incidental fish were examined. This was done particularly in the 1980 and 1981 seasons, when one of us (K.N. Bailey) was studying food and feeding of the incidental species for a Master of Science thesis in zoology. Most of the following data have been extracted from that study. In addition, data from some specimens which were examined in earlier seasons are included.

Methods

Ministry of Agriculture and Fisheries observers, who were aboard the vessels to record data on the skipjack resource and fishery, also collected data on the incidental fish species. Mostly they simply recorded lengths, but when time and opportunity allowed, stomachs or entire alimentary tracts were removed and preserved in formalin.

At the laboratory the stomachs were opened and the following steps taken:

1. Each stomach was evaluated for fullness by allotting "stomach points" as follows: full stomach, 20; three-quarters full, 15; half full, 10; one-third full, 7; one-quarter full, 5; a trace of food, 2; empty, 0. Empty stomachs were not included in further analyses.

2. Points were distributed among the individual food items present. Items were identified to species where possible, but the level of identification depended on their condition (that is, whether the items were complete and the extent of digestion that had taken place) and on the information available on their systematic positions. Each item was thus recorded in relation to the whole of the stomach contents.

3. The number of fish containing food in the sample was multiplied by 20 (that is, the maximum number of points allotted to a stomach) to obtain the maximum number of possible points.

4. The volume percentages for each food item were determined as percentage of the total points allotted to the sample (% diet in the tables) and percentage of the maximum possible points (% volume). The latter is therefore a measure of the stomach volume occupied by each food item.

5. Numbers of food items were also recorded and the numbers converted to percentages of the total number of food items in the samples (% number).

Analyses were carried out on 1275 fish from 27 species (Table 1).

For albacore an additional analysis was made to relate food size and type to fish length. Stomachs were examined as in 1-3 above. The proportion of each food item as a percentage of the diet was then calculated (4 above) for successive 5-cm fork length groupings of albacore. Food items were subsequently placed into 1 of 3 broad categories: crustaceans (small), cephalopods (medium), or teleosts (large).

In addition, some albacore received cursory examination in all seasons from 1976 to 1980, which entailed shipboard dissection, the noting of stomach contents, and, occasionally, the relative volumes of contents.

Food and feeding data are presented in Tables 2-5.

Discussion

The presence of many of the incidental fish species in the catches was probably due to the occurrence of the euphausiid *Nyctiphanes australis* in areas where fishing for skipjack took place. This swarming euphausiid is the principal food of skipjack in New Zealand waters (see publications describing the skipjack fishery). It was also the major food item in the stomachs of 12 of the 27 incidental species.

Amphipods were also common in the stomachs, though usually in lower numbers than *Nyctiphanes*. Like *Nyctiphanes*, amphipods swarm in surface waters in sufficient numbers to make them an important food source for many pelagic fishes.

Other invertebrate groups represented in the diets were siphonophores, polychaete worms, copepods, mysid shrimps, stomatopod (mantis shrimp) larvae, crab larvae, scyllarid phyllosomas, pteropods, and squid.

The larger predators, for example, sharks, marlins, and yellowfin and albacore tuna, showed a definite preference for squid and fish. In addition, albacore exhibited a distinct change in diet as they grew in length. Juvenile fish (35-60 cm fork length) fed almost exclusively on planktonic crustacea; but there was a gradual change in diet to cephalopods and, finally, fairly large fish as the tuna grew.

Acknowledgments

We thank the owners and operators of the purse-seine vessels for providing access to the catches.

Inset

TABLE 1: Incidental fish species examined in the purse-seine skipjack fishery in New Zealand waters, 1980 and 1981

	Scientific name	Common name	Number containing food	Number empty	Total number examined
1	*Isurus oxyrinchus*	Mako shark	1	0	1
2	*Alopias vulpinus*	Thresher shark	2	1	3
3	*Prionace glauca*	Blue shark	1	1	2
4	*Dasyatis brevicaudatus*	Short-tailed stingray	3	1	4
5	*Dasyatis thetidis*	Long-tailed stingray	7	3	10
6	*Mobula* sp.	Manta ray	4	2	6
7	*Sardinops neopilchardus*	Pilchard	25	0	25
8	*Cypsilurus pinnatibarbatus melanocercus*	Flying fish	21	18	39
9	*Scomberesox saurus*	Saury	28	19	47
10	*Remora remora*	Remora	13	24	37
11	*Remora brachyptera*	Remora	4	13	17
12	*Naucrates ductor*	Pilotfish	30	6	36
13	*Trachurus declivis*	Jack mackerel	5	41	46
14	*Brama brama*	Ray's bream	22	0	22
15	*Lepidopus caudatus*	Frostfish	6	0	6
16	*Auxis thazard*	Frigate tuna	25	98	123
17	*Thunnus alalunga*	Albacore tuna	56	34	90
18	*Thunnus albacares*	Yellowfin tuna	2	0	2
19	*Scomber australasicus*	Blue mackerel	42	0	42
20	*Istiompax indica*	Black marlin	9	0	9
21	*Tetrapturus audax*	Striped marlin	8	2	10
22	*Makaira nigricans*	Blue marlin	3	1	4
23	*Centrolophus niger*	Rudderfish	3	0	3
24	*Arothron firmamentum*	Antitropical pufferfish	87	6	93
25	*Lagocephalus cheesemanii*	Pufferfish	1	0	1
26	*Allomycterus jaculiferus*	Porcupine fish	565	11	576
27	*Mola mola*	Sunfish	14	7	21
			987	288	1 275

TABLE 2: Species list, in taxonomic order, of food items eaten by incidental fish species taken in the purse-seine skipjack fishery in New Zealand waters, 1980 and 1981

Phylum Porifera
- Unidentified sponge

Phylum Coelenterata
- Class Hydrozoa
- Order Siphonophora
  - *Chelophyes appendiculata*

Phylum Annelida
- Class Polychaeta
  - Unidentified Errantia

Phylum Arthropoda
- Class Crustacea
- Subclass Copepoda
  - *Candacia* sp.
- Subclass Malacostraca
- Order Peracarida
- Suborder Mysidacea
  - Unidentified mysids
- Suborder Amphipoda
  - *Vibilia armata*
  - *Vibilia viatrix*
  - *Vibilia robusta*
  - *Parathemisto gaudichaudii*
  - *Parathemisto australis*
  - *Hyperoche medusarum*
  - *Phronima sedentaria*
  - *Phrosina semilunata*
  - *Anchylomera blossevillei*
  - *Lycaea pulex*
  - *Brachyscelus crusculum*
  - *Brachyscelus rapacoides*
  - *Platyscelus ovoides*
  - *Hemityphus rapax*
- Order Stomatopoda
  - Unidentified larvae
- Order Eucarida
- Suborder Euphausiacea
  - *Nyctiphanes australis*
  - *Thysanoessa gregaria*
  - *Nematoscelus* sp.
- Suborder Decapoda
  - *Acanthephyra* sp.
  - *Pandalus magnoculus*
  - *Ibacus alticrenatus* (phyllosoma)
  - *Ovalipes catharus* (zoea and megalopa)
  - *Plagusia chubrus* (megalopa)
  - *Lyreidus tridentatus* (megalopa)
  - *Ommatocarcinus huttoni* (zoea)

Inset•

TABLE 2 (ctd.)

Phylum Mollusca

Class Gastropoda

Order Pteropoda

Cavolinia telemus

Cavolinia inflexa

Cavolinia trispinosa

Clio pyramidata

Class Cephalopoda

Order Dibranchia

Suborder Decapoda

Nototodarus sloani

Sepioloidea pacifica

Teuthowenia megalops impennis

Cranchiid sp.

Sepiolid sp.

Unidentified sp.

Phylum Chordata

Class Thaliacea

Order Salpidae

Salpa sp.

Pyrosoma sp.

Class Actinopterygii

Superorder Teleostei

Engraulis australis

Sardinops neopilchardus

Maurolicus muelleri ?

Paralepid sp.

Trachypterus arcticus

Zeus japonicus ? (eggs)

Caranx georgianus

Trachurus sp.

Brama brama

Rexea solandri

Lepidopus caudatus (eggs)

Katsuwonus pelamis

Scomber australasicus

Arothron firmamentum

Unidentified "eel" and "fish" larvae

TABLE 3: Food and feeding data for incidental fish species taken in the purse-seine skipjack fishery in New Zealand waters, 1980 and 1981; numbers in left column refer to incidental fish species as listed in Table 1

	Food item	Points	% diet	% volume	Number	% number
1	Teleostei					
	fish remains	1.0	100.0	5.0		
		1.0	100.0	5.0		
2	Teleostei					
	Katsuwonus pelamis	18.0	47.4	45.0	5	100.0
	fish remains	20.0	52.6	50.0		
		38.0	100.0	95.0	5	100.0
3	Teleostei					
	Trachypterus arcticus	5.0	100.0	25.0	1	100.0
		5.0	100.0	25.0	1	100.0
4	Polychaeta					
	unidentified Errantia	0.5	4.5	0.8	1	2.6
	Amphipoda					
	Parathemisto gaudichaudii	0.5	4.5	0.8	11	29.0
	Phronima sedentaria	0.25	2.3	0.4	2	5.2
	Phrosina semilunata	3.5	31.8	5.9	11	29.0
	Eucarida, Decapoda					
	Ovalipes catharus (megalopa)	0.25	2.3	0.4	1	2.6
	Dibranchia, Decapoda					
	unidentified sp.	0.5	4.5	0.8	3	7.9
	Teleostei					
	fish remains	4.0	36.4	6.7	9	23.7
	Digested matter	1.5	13.7	2.5		
		11.0	100.0	18.3	38	100.0

TABLE 3 (ctd.)

	Food item	Points	% diet	% volume	Number	% number
5	Siphonophora					
	Chelophyes appendiculata	0.25	1.2	0.2	1	20.0
	Amphipoda					
	Phronima sedentaria	3.5	16.7	2.5		
	Phrosina semilunata	1.75	8.3	1.2		
	Anchylomera blossevillei	2.0	9.5	1.4		
	Eucarida, Decapoda					
	Ovalipes catharus (megalopa)	0.5	2.4	0.4	2	40.0
	Pteropoda					
	Cavolinia telemus	4.5	21.4	3.2		
	Cavolinia remains	5.0	23.8	3.6		
	Dibranchia, Decapoda					
	Teuthowenia megalops impennis	1.0	4.8	0.7	1	20.0
	Teleostei					
	fish remains	0.5	2.4	0.4	1	20.0
	Digested matter	2.0	9.5	1.4		
		21.0	100.0	15.0	5	100.0
6	Euphausiacea					
	Nyctiphanes australis	18.0	100.0	22.5	49 020*	100.0
		18.0	100.0	22.5	49 020	100.0
7	Euphausiacea					
	Nyctiphanes australis	381.0	99.7	76.2		
	Stomatopoda					
	unidentified larva	1.0	0.3	0.2	7	
		382.0	100.0	76.4	7	

* Numbers calculated by counting and weighing subsamples.

TABLE 3 (ctd.)

	Food item	Points	% diet	% volume	Number	% number
8	Amphipoda					
	Vibilia armata	1.5	2.1	0.4	14	25.0
	Vibilia sp.	2.75	3.8	0.7		
	Parathemisto gaudichaudii	22.5	31.5	5.3		
	Phronima sedentaria	3.0	4.2	0.7	5	8.9
	Phrosina semilunata	2.25	3.1	0.5		
	amphipod remains	21.0	29.4	5.0		
	Stomatopoda					
	unidentified larva	2.0	2.8	0.5	37	66.1
	Euphausiacea					
	Nyctiphanes australis	1.5	2.1	0.4		
	euphausiid remains	1.0	1.4	0.2		
	Pteropoda					
	Cavolinia telemus	3.0	4.2	0.7		
	Digested matter	11.0	15.4	2.6		
		71.5	100.0	17.0	56	100.0

TABLE 3 (ctd.)

	Food item	Points	% diet	% volume	Number	% number
9	Copepoda					
	Candacia sp.	3.25	2.4	0.6	1 213	
	Mysidacea					
	unidentified remains	0.5	0.4	0.1		
	Amphipoda					
	Parathemisto australis	22.0	16.0	3.9		
	Phronima sedentaria	1.25	1.0	0.2	4	
	Phrosina semilunata	0.25	0.2			
	Amphipod remains	3.5	2.5	0.6		
	Euphausiacea					
	Nyctiphanes australis	70.25	51.2	12.6		
	euphausiid remains	26.0	18.9	4.6		
	Unidentified crustacean remains	5.0	3.6	0.9		
	Teleostei					
	fish remains	0.5	0.4	0.1	1	
	Digested matter	4.75	3.4	0.9		
		137.25	100.0	24.5	1 218	

TABLE 3 (ctd.)

	Food item	Points	% diet	% volume	Number	% number
10	Amphipoda					
	Parathemisto gaudichaudii	3.0	8.8	1.1	6	12.7
	Phronima sedentaria	2.5	7.4	1.0	4	8.5
	Phrosina semilunata	1.5	4.4	0.6	2	4.3
	amphipod remains	10.75	31.6	4.1		
	Euphausiacea					
	Nyctiphanes australis	10.5	30.9	4.0	30	63.8
	Eucarida, Decapoda					
	Ovalipes catharus (megalopa)	1.75	5.2	0.7	3	6.4
	(zoea)	1.0	2.9	0.4	2	4.3
	unidentified decapods	3.0	8.8	1.1		
		34.0	100.0	13.0	47	100.0
11	Amphipoda					
	Parathemisto gaudichaudii	3.0	30.0	3.8		
	Phrosina semilunata	1.0	10.0	1.2	3	
	Anchylomera blossevillei	1.5	15.0	1.9	1	
	amphipod remains	0.5	5.0	0.6		
	Euphausiacea					
	Nyctiphanes australis	4.0	40.0	5.0		
		10.0	100.0	12.5	4	
12	Siphonophora					
	Chelophyes appendiculata	1.0	0.4	0.2	12	0.6
	Amphipoda					
	Vibilia armata	2.75	1.2	0.5	22	1.1
	Vibilia robusta	0.5	0.2	0.1	2	0.1
	Phronima sedentaria	14.0	6.0	2.3	26	1.3
	Phrosina semilunata	1.0	0.4	0.2	3	0.2
	Anchylomera blossevillei	51.0	21.9	8.5	591	30.5
	Brachyscelus crusculum	1.5	0.6	0.2	9	0.5
	Brachyscelus rapacoides	3.75	1.7	0.6	25	1.3
	Platyscelus ovoides	8.25	3.5	1.4	34	1.8

TABLE 3 (ctd.)

	Food item	Points	% diet	% volume	Number	% number
12	(ctd.)					
	Euphausiacea					
	Nyctiphanes australis	108.0	46.3	18.0	1 091	56.2
	Thysanoessa gregaria	8.25	3.5	1.4	106	5.5
	Eucarida, Decapoda					
	Ibacus alticrenatus (phyllosoma)	3.5	1.5	0.6	2	0.1
	Ovalipes catharus (megalopa)	0.25	0.1		1	
	Pteropoda					
	Cavolinia telemus	0.25	0.1		3	0.2
	Dibranchia, Decapoda					
	unidentified sp.	3.5	1.5	0.6	3	0.2
	Salpidae					
	Salpa sp.				1	
	Teleostei					
	Trachurus sp.	0.5	0.2	0.1	1	
	unidentified larva	2.25	1.0	0.4	6	0.3
	fish remains	16.0	6.9	2.7		
	"eel larva"	1.5	0.6	0.2	2	0.1
	Digested matter	5.5	2.4	0.9		
		233.25	100.0	38.9	1 940	100.0
13	Amphipoda					
	unidentified remains	2.0	6.1	2.0		
	Euphausiacea					
	Nyctiphanes australis	1.0	3.0	1.0	5	62.5
	Pteropoda					
	Cavolinia sp.	1.0	3.0	1.0		
	Teleostei					
	Trachurus sp.	29.0	87.9	29.0	3	37.5
		33.0	100.0	33.0	8	100.0

TABLE 3 (ctd.)

	Food item	Points	% diet	% volume	Number	% number
14	Amphipoda					
	Vibilia armata	0.75	0.4	0.2	7	0.4
	Vibilia viatrix	0.25	0.1		1	
	Vibilia robusta	0.75	0.4	0.2	4	0.2
	Vibilia sp.	0.25	0.1		1	
	Parathemisto gaudichaudii	0.5	0.3	0.1		
	Parathemisto australis	6.5	3.6	1.5	210	10.9
	Phronima sedentaria	8.25	4.6	1.9	52	2.7
	Phrosina semilunata	2.75	1.5	0.6	15	0.8
	Anchylomera blossevillei	5.0	2.8	1.1	44	2.3
	Lycaea pulex	0.5	0.3	0.1	13	0.7
	Brachyscelus crusculum	8.75	4.9	2.0	26	1.3
	Brachyscelus rapacoides	8.75	4.9	2.0	17	0.9
	Platyscelus ovoides	6.5	3.6	1.5	46	2.4
	amphipod remains	5.25	3.0	1.2		
	Euphausiacea					
	Nyctiphanes australis	99.75	55.9	22.7	1 465	75.6
	Thysanoessa gregaria	1.0	0.6	0.2	2	0.1
	Stomatopoda					
	unidentified larva	1.75	1.0	0.4	8	0.4
	Eucarida, Decapoda					
	Acanthephyra sp.	0.5	0.3	0.1	1	
	unidentified eucarid larva	0.75	0.4	0.2	1	
	Ovalipes catharus (megalopa)	1.0	0.6	0.2	6	0.3
	Plagusia chubrus (megalopa)	1.0	0.6	0.2	4	0.2
	Lyreidus tridentatus (megalopa)	1.5	0.8	0.3	3	0.2
	Salpidae					
	Salpa sp.	4.5	2.5	1.0	10	0.5
	Teleostei					
	fish remains	6.0	3.4	1.4	2	0.1
	Digested matter	6.0	3.4	1.4		
		178.5	100.0	40.5	1 938	100.0

TABLE 3 (ctd.)

	Food item	Points	% diet	% volume	Number	% number
15	Euphausiacea					
	Nyctiphanes australis	19.5	37.5	16.2	387	90.2
	Eucarida, Decapoda					
	Pandalus magnoculus	8.5	16.4	7.1	29	6.8
	Teleostei					
	Engraulis australis	10.0	19.2	8.3	6	1.4
	fish remains	14.0	26.9	11.7	7	1.6
		52.0	100.0	43.3	429	100.0
16	Euphausiacea					
	Nyctiphanes australis	218.25	98.9	43.6		
	Digested matter	2.5	1.1	0.5		
		220.75	100.0	44.1		
17	Mysidacea					
	unidentified sp.	0.25				
	Amphipoda					
	Parathemisto gaudichaudii	1.0	0.2	0.1	12	1.5
	Phrosina semilunata	14.0	3.2	1.2	116	14.1
	Brachyscelus crusculum	0.75	0.2	0.1	14	1.7
	Brachyscelus rapacoides	0.75	0.2	0.1	22	2.7
	Hemityphus rapax	0.25			1	0.1
	amphipod remains	0.75	0.2	0.1		
	Stomatopoda					
	unidentified larva	11.25	2.6	1.0	230	28.1
	Euphausiacea					
	Nyctiphanes australis	96.25	22.1	8.6		
	Eucarida, Decapoda					
	Acanthephyra sp.	3.5	0.8	0.3	32	4.0
	Ibacus alticrenatus (phyllosoma)	2.5	0.6	0.2	6	0.7
	Ovalipes catharus (megalopa)	2.0	0.5	0.2	21	2.6
	Plagusia chubrus (megalopa)	0.75	0.2	0.1	7	0.9

TABLE 3 (ctd.)

	Food item	Points	% diet	% volume	Number	% number
17	(ctd.)					
	Dibranchia, Decapoda					
	Nototodarus sloani	13.5	3.1	1.2	75	9.1
	Sepioloidea pacifica	4.5	1.0	0.4	13	1.6
	Sepiolid sp.	3.0	0.7	0.3	19	2.3
	Cranchiid sp.	1.0	0.2	0.1		
	unidentified sp.	0.75	0.2	0.1		
	Salpidae					
	Salpa sp.	0.5	0.1		2	0.2
	Teleostei					
	Scomber australasicus	233.0	53.4	20.8	85	10.4
	Paralepid ? sp.	0.75	0.2	0.1	1	0.1
	Rexea solandri	12.0	2.8	1.0	5	0.6
	Maurolicus muelleri ?	8.0	1.8	0.7	71	8.6
	Brama brama	2.0	0.5	0.2	1	0.1
	fish remains	22.0	5.0	1.9	87	10.6
	Digested matter	1.0	0.2	0.1		
		436.0	100.0	38.9	820	100.0
18	Dibranchia, Decapoda					
	Nototodarus sloani	19.0	67.9	47.5	19	90.5
	Teleostei					
	Brama brama	9.0	32.1	22.5	2	9.5
		28.0	100.0	70.0	21	100.0
19	Amphipoda					
	Vibilia armata	0.25			1	
	Parathemisto australis	4.25	0.6	0.5	82	
	Phrosina semilunata	1.5	0.2	0.2	4	
	Platyscelus ovoides	0.5	0.1	0.1	2	
	amphipod remains				1	
	Stomatopoda					
	unidentified larva	1.0	0.1	0.1	6	

TABLE 3 (ctd.)

	Food item	Points	% diet	% volume	Number	% number
19	(ctd.)					
	Euphausiacea					
	Nyctiphanes australis	735.75	99.0	87.6		
	Eucarida, Decapoda					
	Acanthephyra sp.				1	
		743.25	100.0	88.5	97	
20	Dibranchia, Decapoda					
	Nototodarus sloani	13.5	27.0	7.5	18	47.4
	Teleostei					
	Sardinops neopilchardus	9.5	19.0	5.3	13	34.2
	Katsuwonus pelamis	27.0	54.0	15.0	7	18.4
		50.0	100.0	27.8	38	100.0
21	Dibranchia, Decapoda					
	Nototodarus sloani	4.5	7.6	2.8	2	10.0
	Teleostei					
	Caranx georgianus	20.0	33.9	12.5	6	30.0
	Rexea solandri	5.0	8.5	3.1	1	5.0
	Katsuwonus pelamis	26.0	44.1	16.3	7	35.0
	fish remains	3.5	5.9	2.2	4	20.0
		59.0	100.0	36.9	20	100.0
22	Dibranchia, Decapoda					
	Nototodarus sloani	7.0	50.0	11.7	7	77.8
	Teleostei					
	Katsuwonus pelamis	7.0	50.0	11.7	2	22.2
		14.0	100.0	23.4	9	100.0

TABLE 3 (ctd.)

	Food item	Points	% diet	% volume	Number	% number
23	Porifera					
	unidentified	12.0	44.4	20.0		
	Polychaeta					
	unidentified Errantia	0.25	0.9	0.4	1	3.3
	Amphipoda					
	Vibilia armata	0.5	1.9	0.8	3	10.0
	Phronima sedentaria	3.5	13.0	5.9	23	76.7
	Brachyscelus crusculum	0.25	0.9	0.4	2	6.7
	Eucarida, Decapoda					
	Ibacus alticrenatus (phyllosoma)	1.5	5.6	2.5	1	3.3
	Pteropoda					
	unidentified remains	1.0	3.7	1.7		
	Salpidae					
	Salpa sp.	8.0	29.6	13.3		
		27.0	100.0	45.0	30	100.0
24	Siphonophora					
	Chelophyes appendiculata	440.0	76.4	25.3	2 175	63.7
	Mysidacea					
	unidentified sp.	0.5	0.1		8	0.2
	Amphipoda					
	Vibilia armata	4.75	0.8	0.3	24	0.7
	Vibilia sp.	0.5	0.1		3	0.1
	Parathemisto gaudichaudii	8.5	1.5	0.5	78	2.3
	Hyperoche medusarum	28.25	4.9	1.7	370	10.8
	Phronima sedentaria	2.25	0.4	0.2	9	0.3
	Phrosina semilunata	0.25			2	
	Anchylomera blossevillei	1.75	0.3	0.1	22	0.6
	Brachyscelus crusculum	0.5	0.1		3	0.1
	Platyscelus ovoides	5.75	1.0	0.3	13	0.4
	amphipod remains	0.5	0.1			

TABLE 3 (ctd.)

	Food item	Points	% diet	% volume	Number	% number
24	(ctd.)					
	Stomatopoda					
	unidentified larva	0.75	0.1		5	0.2
	Euphausiacea					
	Thysanoessa gregaria	61.0	10.6	3.5	677	19.8
	Eucarida, Decapoda					
	Acanthephyra sp.	0.5	0.1		3	0.1
	Ovalipes catharus (megalopa)	0.5	0.1		3	0.1
	(zoea)	1.5	0.3	0.1	12	0.4
	Ommatocarcinus huttoni (zoea)	0.5	0.1		5	0.2
	Pteropoda					
	Cavolinia inflexa	1.0	0.2	0.1	1	
	Cavolinia trispinosa				1	
	Digested matter	16.25	2.8	0.9		
		575.5	100.0	33.0	3 414	100.0
25	Teleostei					
	Arothron firmamentum	7.0	100.0	35.0	1	100.0
		7.0	100.0	35.0	1	100.0

TABLE 3 (ctd.)

	Food item	Points	% diet	% volume	Number	% number
26	Siphonophora					
	Chelophyes appendiculata	7.25	0.1	0.1	47	0.1
	Amphipoda					
	Vibilia sp.	0.5			2	
	Parathemisto gaudichaudii	4 292.0	82.4	38.0	41 540	88.6
	Phronima sedentaria	4.0	0.1		11	
	Phrosina semilunata	0.5			1	
	Anchylomera blossevillei	1.0				
	Stomatopoda					
	unidentified larva	485.0	9.4	4.3	2 358	5.0
	Euphausiacea					
	Nyctiphanes australis	26.25	0.6	0.2	214	0.5
	Thysanoessa gregaria	2.75			8	
	Nematoscelus sp.	0.5			3	
	unidentified sp.	1.5				
	Eucarida, Decapoda					
	Acanthephyra sp.	193.5	3.7	1.8	744	1.6
	Ovalipes catharus (megalopa)	61.0	1.2	0.5	241	0.5
	(zoea)	70.5	1.4	0.6	938	2.0
	unidentified sp.	0.5			1	
	Pteropoda					
	unidentified remains				1	
	Teleostei					
	Lepidopus caudatus (eggs)	5.25	0.1		326	0.7
	Zeus japonicus ? (eggs)	9.0	0.2	0.1	482	1.0
	unidentified fish larva	0.25			1	
	Digested matter	36.75	0.8	0.3		
		5 198.0	100.0	45.9	46 918	100.0

TABLE 3 (ctd.)

	Food item	Points	% diet	% volume	Number	% number
27	Amphipoda					
	Phronima sedentaria	4.5	5.8	1.6	38	16.2
	Brachyscelus rapacoides	0.5	0.6	0.2		
	Platyscelus ovoides	5.0	6.4	1.8	13	5.5
	Eucarida, Decapoda					
	Ibacus alticrenatus (phyllosoma)	16.75	21.5	6.0	74	31.5
	Ovalipes catharus (megalopa)	1.0	1.3	0.4	10	4.2
	Pteropoda					
	Cavolinia telemus	6.75	8.6	2.4	11	4.7
	Cavolinia trispinosa	0.75	1.0	0.3	8	3.4
	Clio pyramidata	2.75	3.5	1.0		
	Salpidae					
	Salpa sp.	34.0	43.6	12.1	74	31.5
	Pyrosoma sp.	6.0	7.7	2.1	7	3.0
		78.0	100.0	27.9	235	100.0

TABLE 4: Food size and food type preferences of albacore tuna (*Thunnus alalunga*) taken in the purse-seine skipjack fishery in New Zealand waters, 1980 and 1981

Fork length (cm)	No. in sample	% diet		
		Crustaceans	Cephalopods	Teleosts
36-40	3	100.0	0	0
41-45	3	100.0	0	0
46-50	7	95.9	0	4.1
51-55	4	59.6	28.9	11.5
56-60	1	62.5	37.5	0
61-65	4	24.4	23.3	52.3
66-70	5	19.6	8.7	71.7
71-75	11	30.1	9.7	60.2
76-80	4	0	0	100.0
81-85	12	0	0	100.0
86-90	1	0	0	100.0
91-95	1	0	33.3	66.7

TABLE 5: Food of incidental fish species receiving cursory examination in the purse-seine skipjack fishery in New Zealand waters between 1976 and 1980

Species	Year examined	Number examined	Stomach contents
Mako shark	1978	1	4 small blue mackerel
	1979	1	digested fish
	1980	2	1 empty; other with small fish
Blue shark	1978	5	3 empty; 1 with 4 small jack mackerel; other with kahawai (*Arripis trutta*)
Pilchard	1978	unknown	*Nyctiphanes australis*
Flying fish	1978	3	*N. australis*
Saury	1978	71	*N. australis*
Jack mackerels	1978	unknown	*N. australis*
Ray's bream	1978	unknown	*N. australis*
Frostfish	1978	3	1 empty; 2 with squid
Frigate tuna	1977	6	all stomachs approx. half full of *N. australis*
	1978	unknown	*N. australis*
	1980	2	*N. australis*
Albacore tuna	1977	24	all empty
	1978	29	*N. australis* and squid
		76	68% *N. australis*; 16% copepods; 9% unidentified crustacean remains; 4% squid; 3% fish
	1980	7	*N. australis*
		4	small squid and crustaceans
Yellowfin tuna	1978	3	squid
		unknown	pilchard and jack mackerels
Blue mackerel	1976	1	"red-white euphausiid"
	1978	20	*N. australis*
	1980	3	"shrimp"
Marlins	1978	5	all empty
Black marlin	1978	2	1 empty; 1 with squid remains
	1980	1	"a few semi-digested mackerel"
Sunfish	1976	1	"full of salps"
	1978	8	4 empty; 4 with "masses of salps"

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